PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04L 12/403, 12/52

A1

(11) International Publication Number: WO 97/36400

(43) International Publication Date: 2 October 1997 (02.10.97)

(21) International Application Number: PCT/SE97/00522

(22) International Filing Date: 25 March 1997 (25.03.97)

(30) Priority Data:
9601133-3 25 March 1996 (25.03.96) SE

(71) Applicant *(for all designated States except US)*: NET INSIGHT AB [SE/SE]; Ingenjörsvägen 3, S-117 43 Stockholm (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: LINDGREN, Per [SE/SE]; Maria Prästgårdsgatan 12, S-118 52 Stockholm (SE). BOHM, Christer [SE/SE]; S:t Paulsgatan 28A, S-118 48 Stockholm (SE). GAUFFIN, Lars [SE/SE]; Orrstigen 18, S-144 44 Rönninge (SE).

(74) Agent: AWAPATENT AB; P.O. Box 45086, S-104 30 Stockholm (SE).

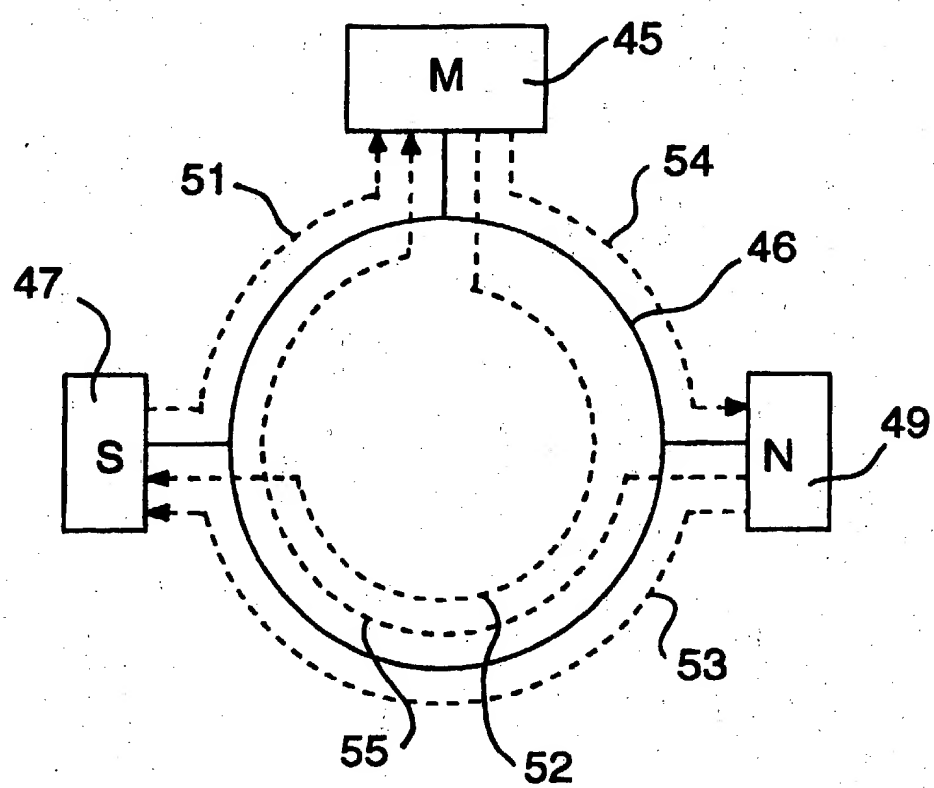
(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
With amended claims.

(54) Title: MASTER NODE ALLOCATION OF TIME SLOTS FOR SLAVE NODES

(57) Abstract

The present invention relates to the field of transferring data in time slots within a frame in a time multiplexing network (46) comprising a master node (45) and a slave node (47), wherein the allocation of time slots (53) for the slave node (47) to use when receiving data from or transmitting data to a third node (49) is controlled by said master node (45).



MASTER NODE ALLOCATION OF TIME SLOTS FOR SLAVE NODES

Technical field of invention

The present invention relates to a method and an arrangement for a simplified interface to a node in a time multiplexed network using time slots in a frame.

Description of related art

New communication networks and protocols are being developed continuously by the communication industry and the academic world. The development is changing all the time, new explorations and results are important to application developers who are seeking to integrate real-time audio, video and asynchronous communication services. The applications reside within a broad spectrum of network terminals. Terminals act as network hosts and may comprise almost any electrical device, including mobile telephones, television sets, multimedia workstations or super computers for millions of dollars. The terminal hosts may differ from one another with respect to processing capacity and the requirements on communication services with many orders of magnitude.

The two basic types of networks are first connection-oriented circuit-switched networks, which are used within for example telecommunication, and second, connection-less packet-switched networks, exemplified by the Internet. When a circuit-switched network is used for computer communication, circuits are left open between bursts of data, which results in waste of resources. This situation occurs due to the fact that the setting up and removal of connections takes too long time compared to the dynamic variations of the user's need. Another source of resource waste in circuit-switched networks is the limitation that only symmetric duplex channels may be established, which results in that only half of the resources allocated to the connection are used when the information flow is simplex. A packet-switched network,

on the other hand, lacks means for resource reservations and must add information to a header in each message before transmission. Furthermore, delays in a packet-switched network are not predictable enough and packets may even be lost during transmission due to buffer limits or destroyed information in the header. The two last factors make it difficult to support real-time services in a packet-switched network.

To address the above mentioned problems the communication industry focuses on the development of ATM (Asynchronous Transfer Mode). CCITT (International Telegraph and Telephone Consultative Committee) has also adopted ATM as standard for B-ISDN (Broadband - Integrated Services Digital Network). ATM is connection-oriented and establishes a channel like circuit-switched networks before transmission, but uses small packets of fixed size, called cells, for transmission of information. ATM's packet-oriented nature requires that the network has mechanisms such as buffer scheduling and link handlers to be able to provide real-time guarantees for a connection.

Another solution to fulfil the requirements on real-time behaviour focuses on circuit-switched networks and must therefore address the typical problems of circuit-switched networks described above. A new protocol for controlling these problems has been developed. A shared medium topology is used why the problems related to such a topology also need to be addressed. This construction, called DTM (Dynamic Synchronous Transfer Mode), (see e.g., C. Bohm, P. Lindgren, L. Ramfelt and P. Sjödin, The DTM Gigabit Network, Journal of High-Speed Networks, 3 (2):109-126, 1994 and L. Gauffin, L Håkansson and B. Pehrson, Multi-gigabit networking based on DTM, Computer Networks and ISDN Systems, 24 (2): 119-139, April 1992), uses channels as communication abstraction. These channels differ from telephony circuits in different ways. First, the channel set-up time is short enough to

allow resources to be allocated/deallocated dynamically according to the demand of the user. Second, channels are simplex, thus minimising the overhead. Third, channels are multirate, which gives the possibility to support large variations in the user's demand of capacity. Finally, channels are inherently multicast, allowing more than one destination.

Access points and terminals within the public network are the most cost sensitive products in the infrastructure of telephony and data communication, and are therefore key components in succeeding to obtain a large connectivity also for homes. There are two possibilities to obtain low cost access, either a simple access protocol is used that allows efficient implementation of low cost nodes, for example at homes, or the network may provide the end user with an infrastructure that allows high communication capacity that makes it possible for server nodes to interact with simple terminals. A first step in the latter direction has been shown for example with the network computer concept, where the network is stripped with for example very little memory and own disk capacity.

It has proven difficult to implement terminals for a large number of users that both allows for high data capacity and that are inexpensive enough to attract a sufficiently large number of users to be cost efficient. To handle advanced protocols at high transmission rates requires fast processing and advanced software. The larger part of the costs for a broadband node lies within the capability to be able to process incoming data fast enough and some sort of node control often implemented in software. The task of the node control may be to sort out data and control information, negotiate about establishing and releasing channels and negotiation about different grades of service (GOS) with other nodes, to mention some tasks.

Summary of the invention

The object of this invention is thus to obtain a cost efficient solution to be able to offer broadband services in a time multiplexed network.

According to the invention, the above mentioned and other objects are accomplished by a method, an arrangement, a slave node and a master node as claimed in the accompanying claims.

Hence, the present invention provides a solution to the above mentioned problems related to a time multiplexed network, such as a DTM-like network, by providing a master node that is responsible for establishing and removing channels on the behalf of one or several slave nodes, and by reducing the processing and control signalling ability or need of the slave node, which only takes commands from the master node and possibly request services from the master node by sending request messages to the master. This provides possibilities to reduce the hardware and software needed in the slave node.

In a network according to the invention, at least one node in the network is assigned as a master node. Each master node controls a set of slave nodes by determining what channels or time slots that are set up to and from its slaves in relation to a third node, i.e. which channels or time slots that the slave node shall write/read through when communication to a third node, the third node being the master node, another slave node or any other kind of node. The master also manages all signalling with other nodes, for example to negotiate establishing and removing channels (channel management), handling the network resources on behalf of its slaves (resource management) and it may also handle other sorts of network management, such as fault management and accounting. This allows for implementing the slave nodes with a simple technique without complicated and expensive processing capabilities for signalling, protocol proces-

sing and management, etc., thus obtaining a non-expensive node solution.

To allow for the master to give commands to a slave, instructing it to read or write into a certain time slot, or slot for short, there needs to be a command channel set up between the master and the slave. On this command channel, special commands are sent from the master, instructing the slave to receive data from or transmit data into one or several time slots of a channel. Within the slave there is a function that listens to the command channel and performs the orders of the command words. Since this function is very specialised, it can be easily implemented, for example in a Programmable Logic Device (PLD) or a small Field Programmable Gate Array (FPGA), and thereby an efficient handling even of very high-rate data streams is obtained without expensive and complicated software and hardware. When this function finds that a command word contains relevant information, the function interprets the data of the command word and sets an entry in the channel table in order for the slots that were appointed by the master via the command word to be read or written into by the slave.

Which time slot that is to be used for the command channel between the master and the slave may be predetermined in the network and can be stored in the slave, for example in a flash memory or Read Only Memory (ROM). Another alternative is to let the assignment of time slot to the command channel be dynamically set by letting the slave search for a given slot pattern, sent out by the master. The master either sends this pattern in the time slot that is to act as command channel, or sets a value in the special slot that tells the slave what slot to use for the command channel.

The slave node may also send a message (a request) to the master, informing that the slave wants the master to perform a certain service or a certain function. This service may be that the master contacts another node in

the network or on another subnetwork on the behalf of the slave, for example to set up a channel from the other node to the slave. The master is then responsible for doing all the necessary control signalling to establish a channel between the other node and the slave node.

Further aspects and features of the invention will be apparent from the detailed description below and the accompanying claims.

Brief description of the drawings

Exemplifying embodiments of the invention will now be described in greater detail with reference to accompanying drawings, in which:

Fig 1 schematically illustrates a first embodiment according to of the invention;

Fig 2 schematically illustrates a second embodiment according to of the invention;

Fig 3 schematically illustrates a receiving unit of a slave node according to another embodiment of the invention;

Fig 4 schematically illustrates a transmitting unit of a master node according to another embodiment of the invention;

Fig 5 schematically illustrates a transmitting unit of a slave node according to another embodiment of the invention;

Fig 6 schematically illustrates the start-up of a slave node according to another embodiment of the invention; and

Fig 7 schematically illustrates how the slave node receives commands from the master node according to another embodiment of the invention.

Detailed description of preferred embodiments

Fig 1 shows an embodiment of the invention, wherein a master node 45 controls a slave nodes 47 over a subnetwork 46 to which a third node 49 is attached, which node

47 for example may be another slave node or a "normal node". The information in the subnetwork 46 is transported in frames or cycles that are further divided into time slots. The slave node 47 may send data in one time slot per frame, the request channel or slot 51, to request a function or a service from the master node 45. In this exemplifying scenario, the request message contains a request for an incoming channel of which the third node 49 is the source. The master node 45 then handles all necessary signalling with the third node 49 (channel 54 and 55), among other things asking the third node 49 about what slots are used for the channel requested by the slave node 47, on behalf of its slave node. The third node announces the channel (channel 53 in this case) via its usual control channel 55 to the master node. The master then uses its command channel 52 to the slave node 47 to instruct the slave node 47 to listen to the correct time slots, i.e. channel 53.

Figure 2 shows another embodiment of the invention, comprising two subnetworks 31 and 32, a switch node 33 that switches channels between the two subnetworks, a master node 34 that controls a slave node 35 over the subnetwork 31, and a third "normal" node 36 that is attached to second subnetwork 32. Hence, to illustrate that the invention can be implemented on both bus and ring topology, Fig 2 shows a system with dual buses. Note that the subnetwork 32, not attaching the master and slave node, need not necessarily be a time multiplexed network, even though this is a preferred situation.

The information in the subnetwork 31 is transported in frames that are further divided into time slots. The slave node 35 may send request data in one time slot per frame, the request channel 21, to request a function or a service from the master node 34. In this exemplifying scenario, the request message on channel 21 contains a request for an incoming channel of which the third node 36 on the other subnetwork 32 is the source. The master

node 34 then negotiates with the third node 36 via the switch node 33, the master nodes 34 using its control channel 50 to ask for a channel from the node 36 to be switched via the switch node 33, which switches the channel 42 from subnetwork 32 to the channel 43 in the subnetwork 31. The switch node 33 tells the master node 34 what slots are used for the switched channel from the node 36 using the switch nodes usual control channel 22. The master node 34 then uses its command channel 20 to the slave node 35 (one time slot per frame) to set up the slave node 35 to listen to the correct time slots, i.e. to listen to channel 43. In Fig 2, it is indicated that the connection between subnetwork 32 and subnetwork 31 is provided via the switch node 33. This is of course not necessary. For example, the master node 34 could also act as the switch node.

Figure 3 shows a receiving unit which may be similar for both a slave node and a master node. The receiving unit comprises a demultiplexer 1 which demultiplexes a serial bitstream 2 that arrives on a transferring media 3. The receiving unit further comprises a time slot counter 4 to address a channel table which has one entry 6a-6g for each time slot of a frame (a-g). Each entry 6a-6g is divided in at least two parts; a flag 9a-9g indicating whether the corresponding slot is to be read into the node, and an LCI (Logical Channel Identifier) 10a-10g. The LCI is used to forward the incoming data to the correct end user 12 in the node. If, when the time slot counter 4 is addressing entry 6c, the flag 9c indicates that the time slot c should be read into the node, the slot is read from the demultiplexer and combined with the LCI 10c and is placed in the buffer 11 where the data, depending on what the LCI 10c indicates, is forwarded to the correct end user 12. This procedure may be the same for all nodes.

Figure 4 shows an exemplifying embodiment of how a master node sends data. The master node comprises a time

slot counter 25, which is incremented for each time slot in the frame that passes the master node. The time slot counter 25 addresses a channel table 14 which, in the same way as for the receiving unit, has one entry for each time slot a-g in a frame. However, in this case the counter is pointing a number of slots ahead. That is if the slot passing the node slot b in the frame, the time slot counter 25 may point at entry corresponding to slot d in the channel table 14. The offset between the passing time slot and the time slot the time slot counter is pointing at depends on the bit rate of the link and the processing capacity of the master node.

If the flag 17d of the entry of the channel table indicates that the master node should send data in the corresponding time slot d, a request for data to put in that slot d is sent to the transmitting user 13 indicated by the LCI 37d of the entry. The end user 13 copies data directly to a memory 23 corresponding to the entry d of the channel table. At the same time, the time slot counter 25 also addresses the memory 23 at the entry 18b corresponding to the passing time slot b. If the flag 17b indicates that the node should send in the passing time slot b, the passing data is blocked and the data from the memory entry 18b is passed to the multiplexer 19 that forwards it onto the link.

In figure 5, the slave node's request transmitting unit and procedure is presented, which can be implemented in a much simpler way than compared to conventional nodes. Naturally, the transmitting unit of the slave node can be implemented as in the master node, but since the slave node only needs to send simple requests the implementation can be simplified, as will be described below.

The slave node comprises a register 20 which contains the slot number 21d which the slave should use to send requests to a master. When the slave node wants to send a request to the master node, it writes data into

a FIFO-queue (First-In-First-Out) 32. If there is data to be sent in the FIFO queue 32 when the time slot d, corresponding to the request channel to the master node, passes on the fiber 31, i.e. when the time slot counter 28 points at the request slot number 21d in the register 20, the data at the head of the FIFO-queue 32 is forwarded via a multiplexer 22 onto the link 31 in that time slot d of the bitstream 30.

There may be several reasons why a slave node may want to send data to the master node. For example, the slave node may want to change the incoming data to another channel in a video on demand or TV application, or change of WWW page in an Internet application. The possibility to a simplified procedure is allowed by the fact that the slave node only sends data to the master and that it only uses one sending channel, the request channel. The master node and the slave node must of course agree on the time slot to be used for the request channel, it may also exist restrictions on when the time slot can be used if several slave nodes share the same time slot. The master node and the slave node may agree on what time slot to use, for example by having the slave node be preset, for example by using a flash or prom memory, or by letting the master node instructing the slave node by sending a command word in the command channel, indicating what time slot to use for the request channel.

As is understood by those skilled in the art, the embodiment in Fig 5 could easily be adapted for transmitting other data than request data from the slave.

Figure 6 shows the procedure when a new slave node is attached to the network or is activated. The slave node does not have a signalling protocol implementation, but a reduced slave function for interpreting command words from the master. The function reads a Programmable Read Only Memory (PROM) 35, which contains data 37 that is copied to the entry 40e in the flag table 40 and data

36 containing a flag 36b and an LCI 36a which are copied into the entry 41f in the channel table 41. The LCI 36a indicates that incoming data from that time slot should be interpreted by the reduced slave function that handles incoming command words from the master node. The node is now activated and may receive command words on the time slot corresponding to entry 41f in the channel table. The slave node may also send information (request messages) in the time slot corresponding to entry 40e in the flag table.

Figure 7 shows an exemplifying procedure wherein the master node commands the slave node to read certain time slots. When the time slot counter 4 in the slave node points at an entry 43f in the channel table 42, data from the master node is copied from the corresponding time slot f. The entry 43f of the channel table indicates that the incoming data 44 belongs to the command channel and are thus destined for the reduced slave function (RNC). The reduced slave function reads the data field 44B of the command word 44 which indicates that the data fields 44C-4D should be written into the entries 43b-43d in the channel table 42. The only assignment the reduced slave function has in this implementation is to copy data received in a special time slot (f) into indicted entries (b-d) in the memory 42. The reduced slave function may also have more advanced assignments, such as interpretation of incoming messages (command words). The information about what time slots for the slave node to read may also arrive in several separate command words. The result of the above procedure is that the slave node now is set to read data also in the time slots b-d corresponding to the entries 43b-43d and that the end user of the data received in these slots is VOD. VOD represents an end user attached to the slave node that is to receive data. The master node has information about which end users that are attached to the slave node.

As is understood, the invention is not limited to the embodiments described above with reference to the drawings, but can easily be modified within the scope of the accompanying patent claims. The invention is further not restricted to DTM networks but can be used in any time multiplexed networks with cycles and time slots of arbitrary sizes.

CLAIMS

1. A method for transferring data in time slots within a frame in a time multiplexing network comprising a master node and a slave node, wherein the master node acts as a representative for said slave node in the management of channels between the slave node and a third node.

2. A method as claimed in claim 1, wherein said master node provides instuctions to said slave node relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

3. A method as claimed in claim 1 or 2, wherein said master node controls the allocation of time slots for the slave node to use when transmitting data to said third node.

4. A method as claimed in any one of the preceding claims, wherein said time slots are divided into control slots for control signalling and data slots for transferring user data.

5. A method as claimed in any one of the preceding claims, wherein said data transferring is performed in accordance with a Dynamic Synchronous Transfer Mode (DTM) protocol.

6. A method as claimed in any one of the preceding claims, wherein a or said instruction is sent from the master node to the slave node in one or more specific slots.

7. A method as claimed in claim 6, wherein information relating to which specific slot or slots is to be

used for the transfer of said instruction from the master node to the slave node is stored in the slave node.

8. A method as claimed in claim 6 or 7, wherein the slave node reads all slots, searching for a specific pattern, said pattern providing instructions as to which specific slot or slots is to be used for the transfer of said instruction from the master node to the slave node.

9. A method as claimed in claim 8, wherein the slave node, when detecting said specific pattern in a time slot, sets said time slot containing the pattern as the specific slot which is to be used for the transfer of said instruction from the master node to the slave node.

10. A method as claimed in any one of the preceding claims, wherein said third node is provided within said time multiplexing network.

11. A method as claimed in any one of the preceding claims, wherein said third node is provided outside said time multiplexing network, i.e. in a network of arbitrary design.

12. A method as claimed in any one of the preceding claims, further comprising:

providing, in said slave node, a table including a set of entries, each entry corresponding to a specific slot in the frame and providing information as to whether or not said corresponding slot shall be read and as to which slave node function or attached user are to receive the information in said corresponding slot;

counting the time slots that arrives at the slave node;

searching the entry in said table corresponding to the time slot arriving at the slave node;

reading said time slot arriving at the slave node if the information provided in said entry corresponding to said time slot states that it shall be read and, if so, providing the read message to the slave node function or attached user identified in said entry.

13. A method as claimed in claim 12, wherein:

said instruction relating to which time slots the slave node is to read, preferably provided in a control slot, includes two parts, the first part stating which entries in said table the second part shall be copied into; and

said slave node copies the second part into the entries in said table stated by said first part.

14. A method as claimed in any one of the preceding claims, wherein the slave node selects a function or service to be performed by the master node by sending a message to the master node in a second specific slot.

15. A method as claimed in claim 14, wherein information relating to which time slot is to be used as said second specific slot is stored in the slave node.

16. A method as claimed in claim 14 or 15, wherein information relating to which time slot is to be used as said another specific slot is provided from the master node to the slave node using a or said specific slot or slots.

17 A method as claimed in any one of the preceding claims, further comprising:

providing, in said slave node, a table inciuding a set of entries, each entry corresponding to a specific slot in the frame and providing information as to whether or not information may be written into said corresponding slot;

providing, in said slave node, at least one queue comprising data to be sent from the slave node to the master node;

counting the time slots that passes the slave node;

searching the entry in said table corresponding to the time slot passing the slave node; and

sending information stored at a first position in said at least one queue in said time slot passing the slave node if the information provided in said entry corresponding to the time slot passing the slave node states that the slave node may write into said slot.

18. An arrangement for transferring data in time slots within a frame in a time multiplexing network comprising a master node and a slave node, wherein the master node is arranged to act as a representative for said slave node in the management of channels between the slave node and a third node.

19. An arrangement as claimed in claim 18, wherein said master node is arranged to provide instuctions to said slave node relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

20. An arrangement as claimed in claim 18 or 19, wherein said master node is arranned to control the allocation of time slots for the slave node to use when transmitting data to said third node.

21. An arrangement as claimed in claim 18, 19 or 20, wherein said master node comprises means for providing a or said instruction in a specific slot to said slave node, said instruction relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

22. An arrangement as claimed in claim 18, 19 20 or 21, wherein said time multiplexing network comprises said third node.

23. An arrangement as claimed in any one of claims 18-22, wherein said third node is provided outside said time multiplexing network.

24. An arrangement as claimed in any one of claims 18-23, wherein said network is circuit switched.

25. A slave node for receiving or transmitting data in time slots within a frame in a time multiplexing network, comprising means for receiving instructions from a master node, said master node acting as a representative for said slave node in the management of channels between the slave node and a third node, said instruction relating to which time slots the slave node shall use when receiving data from or transmitting data to said third node.

26. A slave node as claimed in claim 25, wherein said receiving means is arranged to receive said instructions in a specific slot from said master node.

27. A slave node as claimed in claim 25 or 26, further comprising:

means for storing a table including a set of entries, each entry corresponding to a specific time slot in the frame and providing information as to whether or not said corresponding time slot shall be read and as to which slave node function or attached user is to receive the information in said corresponding time slot;

means for counting the time slots that arrives at the slave node;

means for searching the entry in said table corresponding to the counted time slot arriving at the

slave node and for reading said time slot arriving at the slave node if the information provided in said entry corresponding to said time slot states that it shall be read and, if so, providing the read message to a slave node function or attached user identified in said entry.

28. A slave node as claimed in claim 25, 26 or 27, further comprising means for selecting a function or service to be performed by the master node by sending a message to the master node in a second specific slot.

29. A slave node as claimed in claim 28, further comprising means for storing information relating to which time slot is to be used as said second specific slot.

30. A slave nod as claimed in claim 28 or 29, further comprising:

means for storing a table including a set of entries, each entry corresponding to a specific slot in the frame and providing information as to whether or not information may be written into said corresponding slot;

means for storing at least one queue comprising data to be sent from the slave node to the master node;

means for counting the time slots that passes the slave node; and

means for searching the entry in said table corresponding to the time slot passing the slave node and sending information stored at a first position in said at least one queue in said time slot passing the slave node if the information provided in said entry corresponding to the time slot passing the slave node states that the slave node may write into said slot.

31. A master node for controlling data transferring in time slots within a frame in a time multiplexing network, said master being arranged to acts as a representa-

tive for a slave node in the management of channels between the slave node and a third node.

32. A master node as claimed in claim 31, wherein said master node comprises means for providing instuctions to said slave node relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

33. A master node as claimed in claim 32, wherein said master node is arranged to control the allocation of time slots for said slave node to use when transmitting data to said third node.

33. A master node as claimed in claim 31, 32 or 33, further comprising means for transmitting a or said instruction in a slot to said slave node, said instruction relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

AMENDED CLAIMS

[received by the International Bureau on 28 July 1997 (28.07.97); original claims 1, 18, 25 and 31 amended; remaining claims unchanged (7 pages)]

1. A method for transferring data in time slots of a cycle in a synchronous time multiplexing network, comprising the use of a master node and a slave node, wherein the master node acts as a representative for said slave node in the management of channels between the slave node and any third node.

2. A method as claimed in claim 1, wherein said master node provides instuctions to said slave node relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

3. A method as claimed in claim 1 or 2, wherein said master node controls the allocation of time slots for the slave node to use when transmitting data to said third node.

4. A method as claimed in any one of the preceding claims, wherein said time slots are divided into control slots for control signalling and data slots for transferring user data.

5. A method as claimed in any one of the preceding claims, wherein said data transferring is performed in accordance with a Dynamic Synchronous Transfer Mode (DTM) protocol.

6. A method as claimed in any one of the preceding claims, wherein a or said instruction is sent from the master node to the slave node in one or more specific slots.

7. A method as claimed in claim 6, wherein information relating to which specific slot or slots is to be

used for the transfer of said instruction from the master node to the slave node is stored in the slave node.

8. A method as claimed in claim 6 or 7, wherein the slave node reads all slots, searching for a specific pattern, said pattern providing instructions as to which specific slot or slots is to be used for the transfer of said instruction from the master node to the slave node.

9. A method as claimed in claim 8, wherein the slave node, when detecting said specific pattern in a time slot, sets said time slot containing the pattern as the specific slot which is to be used for the transfer of said instruction from the master node to the slave node.

10. A method as claimed in any one of the preceding claims, wherein said third node is provided within said time multiplexing network.

11. A method as claimed in any one of the preceding claims, wherein said third node is provided outside said time multiplexing network, i.e. in a network of arbitrary design.

12. A method as claimed in any one of the preceding claims, further comprising:

providing, in said slave node, a table including a set of entries, each entry corresponding to a specific slot in the frame and providing information as to whether or not said corresponding slot shall be read and as to which slave node function or attached user are to receive the information in said corresponding slot;

counting the time slots that arrives at the slave node;

searching the entry in said table corresponding to the time slot arriving at the slave node;

reading said time slot arriving at the slave node if the information provided in said entry corresponding to said time slot states that it shall be read and, if so, providing the read message to the slave node function or attached user identified in said entry.

13. A method as claimed in claim 12, wherein:

said instruction relating to which time slots the slave node is to read, preferably provided in a control slot, includes two parts, the first part stating which entries in said table the second part shall be copied into; and

said slave node copies the second part into the entries in said table stated by said first part.

14. A method as claimed in any one of the preceding claims, wherein the slave node selects a function or service to be performed by the master node by sending a message to the master node in a second specific slot.

15. A method as claimed in claim 14, wherein information relating to which time slot is to be used as said second specific slot is stored in the slave node.

16. A method as claimed in claim 14 or 15, wherein information relating to which time slot is to be used as said another specific slot is provided from the master node to the slave node using a or said specific slot or slots.

17 A method as claimed in any one of the preceding claims, further comprising:

providing, in said slave node, a table including a set of entries, each entry corresponding to a specific slot in the frame and providing information as to whether or not information may be written into said corresponding slot;

providing, in said slave node, at least one queue comprising data to be sent from the slave node to the master node;

counting the time slots that passes the slave node;

searching the entry in said table corresponding to the time slot passing the slave node; and

sending information stored at a first position in said at least one queue in said time slot passing the slave node if the information provided in said entry corresponding to the time slot passing the slave node states that the slave node may write into said slot.

18. An arrangement for transferring data in time slots of a cycle in a synchronous time multiplexing network, comprising a master node and a slave node, wherein the master node is arranged to act as a representative for said slave node in the management of channels between the slave node and any third node.

19. An arrangement as claimed in claim 18, wherein said master node is arranged to provide instuctions to said slave node relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

20. An arrangement as claimed in claim 18 or 19, wherein said master node is arranged to control the allocation of time slots for the slave node to use when transmitting data to said third node.

21. An arrangement as claimed in claim 18, 19 or 20, wherein said master node comprises means for providing a or said instruction in a specific slot to said slave node, said instruction relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

22. An arrangement as claimed in claim 18, 19 20 or 21, wherein said time multiplexing network comprises said third node.

23. An arrangement as claimed in any one of claims 18-22, wherein said third node is provided outside said time multiplexing network.

24. An arrangement as claimed in any one of claims 18-23, wherein said network is circuit switched.

25. A slave node for receiving or transmitting data in time slots of a cycle in a synchronous time multiplexing network, comprising means for receiving instructions from a master node, said master node acting as a representative for said slave node in the management of channels between the slave node and any third node, said instruction relating to which time slots the slave node shall use when receiving data from or transmitting data to said third node.

26. A slave node as claimed in claim 25, wherein said receiving means is arranged to receive said instructions in a specific slot from said master node.

27. A slave node as claimed in claim 25 or 26, further comprising:

means for storing a table including a set of entries, each entry corresponding to a specific time slot in the frame and providing information as to whether or not said corresponding time slot shall be read and as to which slave node function or attached user is to receive the information in said corresponding time slot;

means for counting the time slots that arrives at the slave node;

means for searching the entry in said table corresponding to the counted time slot arriving at the

slave node and for reading said time slot arriving at the slave node if the information provided in said entry corresponding to said time slot states that it shall be read and, if so, providing the read message to a slave node function or attached user identified in said entry.

28. A slave node as claimed in claim 25, 26 or 27, further comprising means for selecting a function or service to be performed by the master node by sending a message to the master node in a second specific slot.

29. A slave node as claimed in claim 28, further comprising means for storing information relating to which time slot is to be used as said second specific slot.

30. A slave nod as claimed in claim 28 or 29, further comprising:

means for storing a table including a set of entries, each entry corresponding to a specific slot in the frame and providing information as to whether or not information may be written into said corresponding slot;

means for storing at least one queue comprising data to be sent from the slave node to the master node;

means for counting the time slots that passes the slave node; and

means for searching the entry in said table corresponding to the time slot passing the slave node and sending information stored at a first position in said at least one queue in said time slot passing the slave node if the information provided in said entry corresponding to the time slot passing the slave node states that the slave node may write into said slot.

31. A master node for controlling the transfer of data in time slots of a cycle in a synchronous time multiplexing network, said master being arranged to act

as a representative for a slave node in the management of channels between the slave node and any third node.

32. A master node as claimed in claim 31, wherein said master node comprises means for providing instuctions to said slave node relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

33. A master node as claimed in claim 32, wherein said master node is arranged to control the allocation of time slots for said slave node to use when transmitting data to said third node.

33. A master node as claimed in claim 31, 32 or 33, further comprising means for transmitting a or said instruction in a slot to said slave node, said instruction relating to which time slots the slave node is to use for receiving data from or transmitting data to said third node.

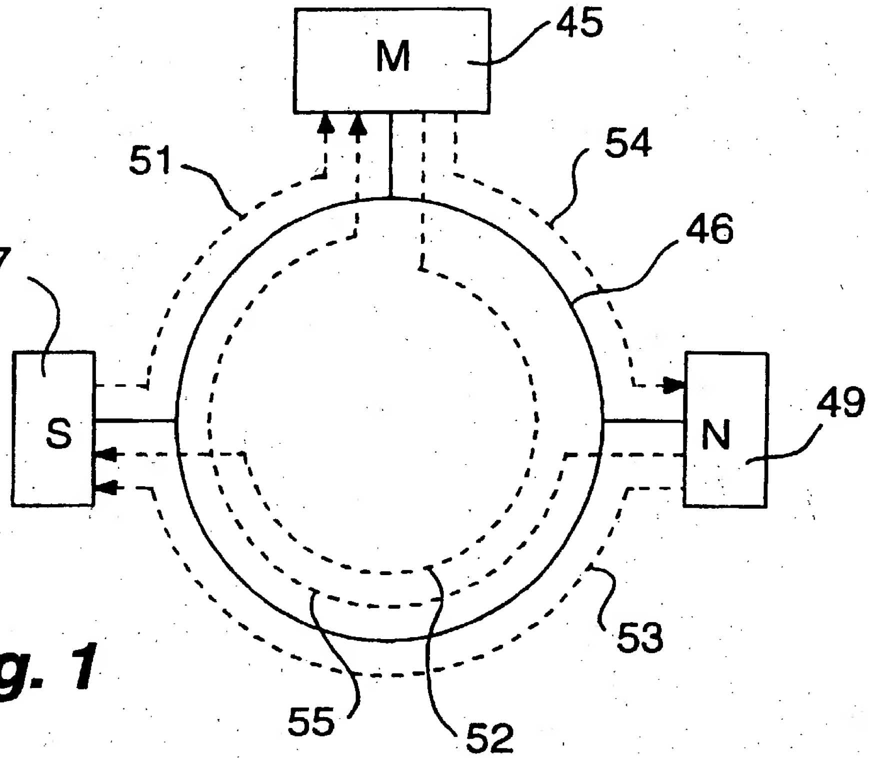

M
45
51
54
46
47
S
N
49
53
55
52

Fig. 1

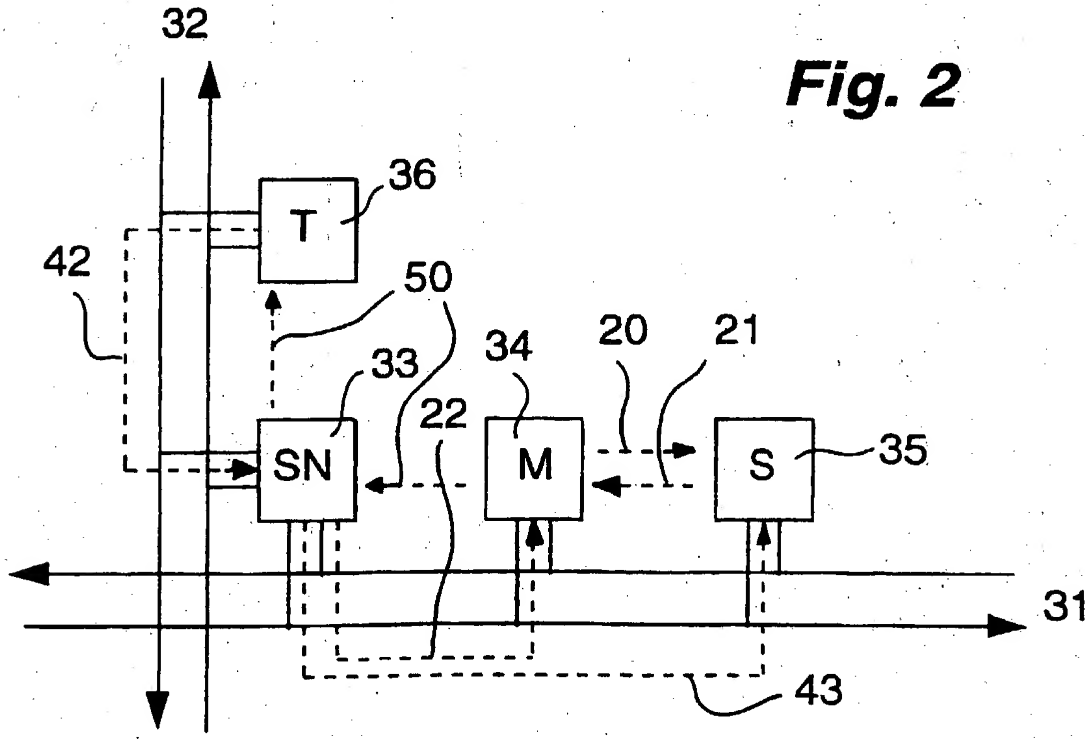

32
T
36
42
50
33
34
20
21
22
SN
M
S
35
31
43

Fig. 2

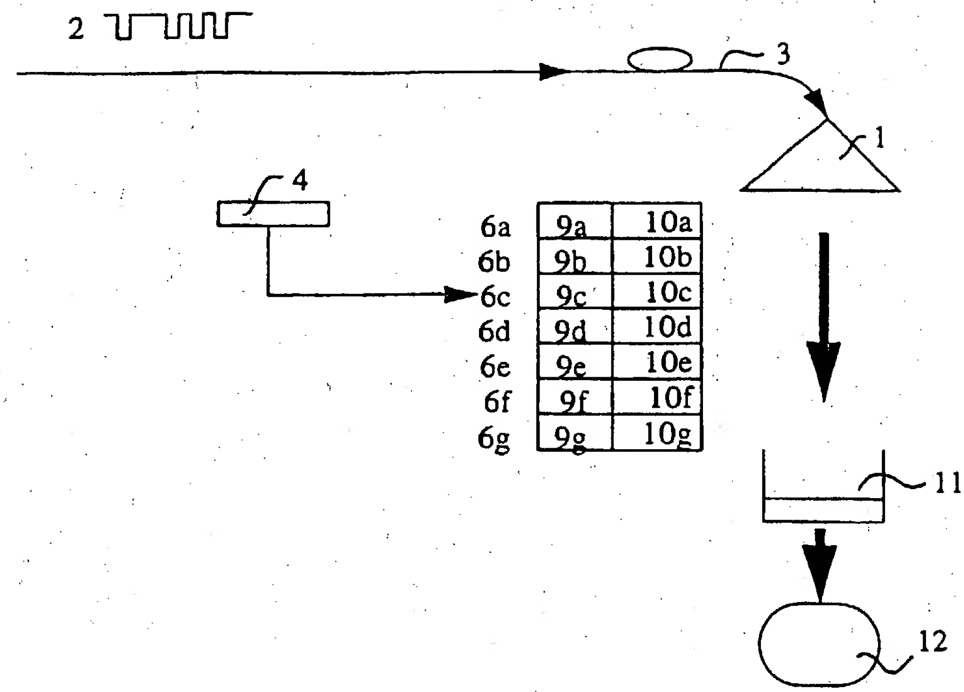

2
3
1
4
6a
6b
6c
6d
6e
6f
6g
9a
9b
9c
9d
9e
9f
9g
10a
10b
10c
10d
10e
10f
10g
11
12

Fig. 3

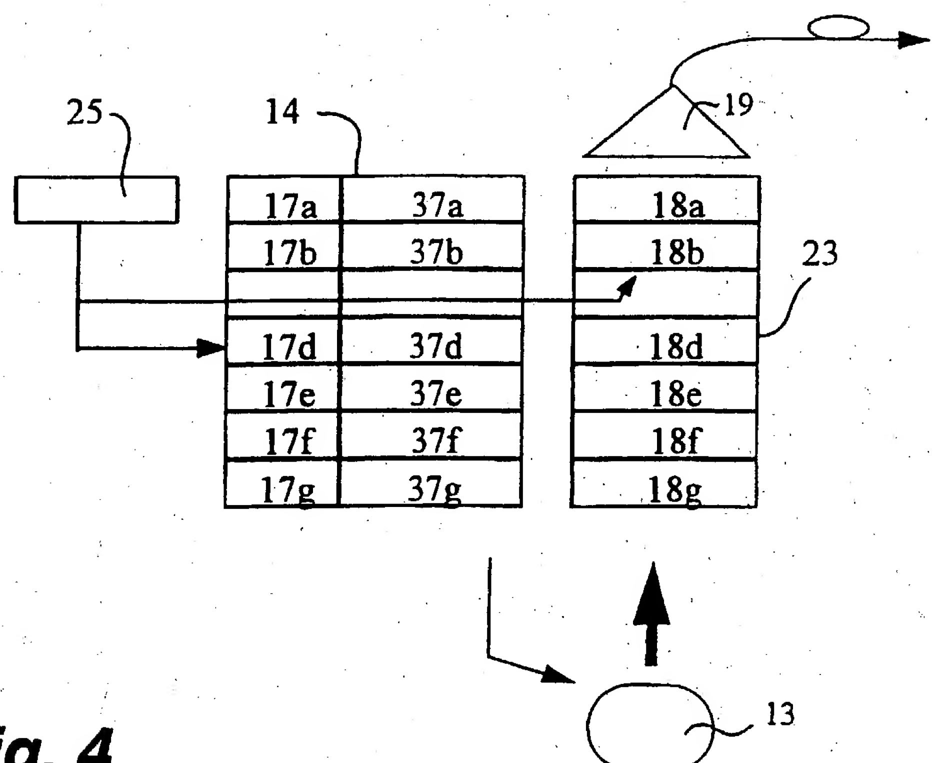

25
14
19
17a
17b
17d
17e
17f
17g
37a
37b
37d
37e
37f
37g
18a
18b
18d
18e
18f
18g
23
13

Fig. 4

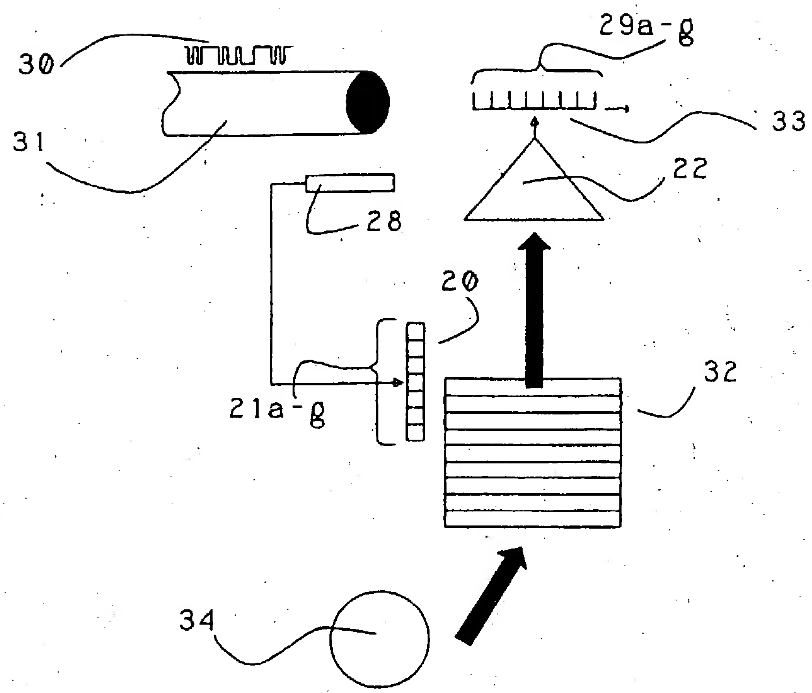

29a-g
30
33
31
22
28
20
32
21a-g
34

Fig. 5

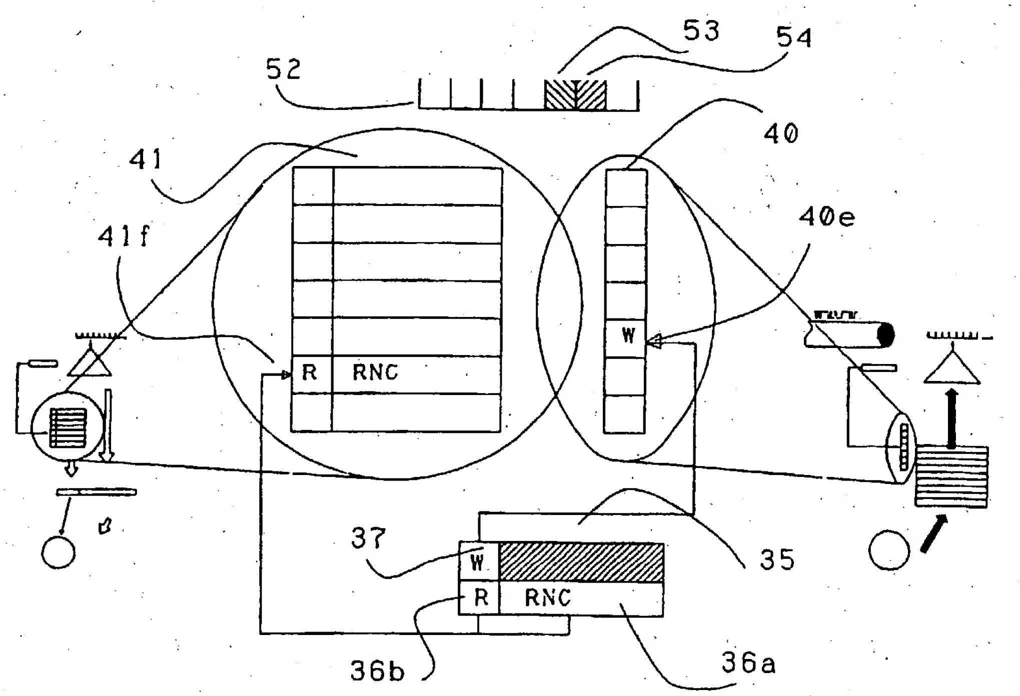

53
54
52
40
41
40e
41f
W
R
RNC
37
35
W
R
RNC
36b
36a

Fig. 6

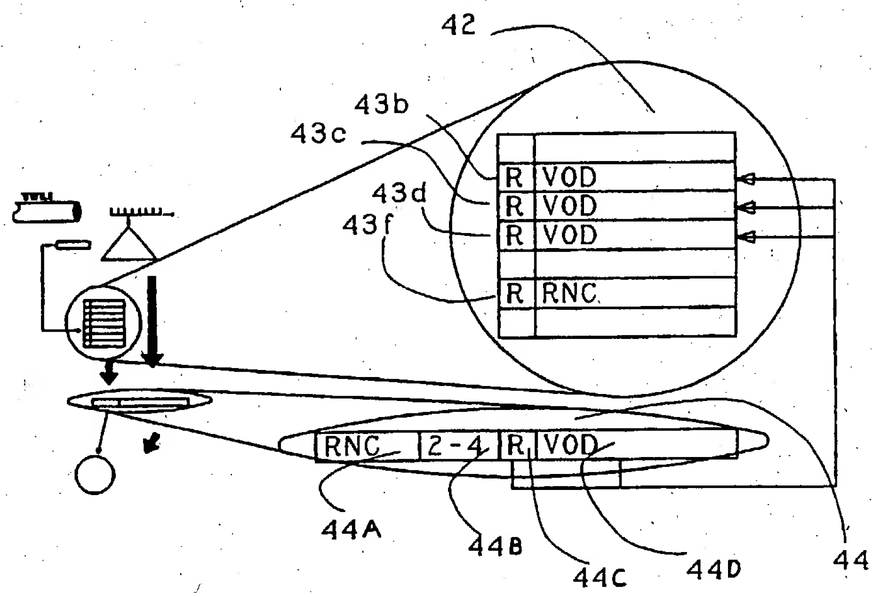

42
43b
43c
43d
43f
R VOD
R VOD
R VOD
R RNC
RNC
2-4
R
VOD
44A
44B
44C
44D
44

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00522

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04L 12/403, H04L 12/52

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IEEE Journal on Selected Areas in Communications, Volume 14, No 2, February 1996, Christer Bohm et al, "Fast Circuit Switching for the Next Generation of High Performance Networks", abstract, page 299, left col. two last paragraphs - right col. first paragraph; page 300 section"C.DTM Channels"	1-8,18-26, 31-33
Y		12,27
A		9-11,13-17, 28-30
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" erlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 July 1997	04.07.1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Anders Ströbeck Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00522

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Computer Networks and ISDN Systems pp.119-130, Volume 24, No 2, April 1992, (Amsterdam), Lars Gauffin, "Multi-Gigabit Networking Based on DTM", figures 3,6, see page 122; page 124, "Data Structures"; page 125, "Destination"	12,27
A		1-11,13-26, 28-33
	--	
X	WO 8908363 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 8 Sept 1989 (08.09.89), page 4, line 19 - page 6, line 11, figures 2,3, abstract	1-8,18-26, 31-33
A		9-17
	--	
X	EP 0477659 A1 (ALCATEL FACE S.P.A), 1 April 1992 (01.04.92), column 1, line 25 - line 47; column 3, line 19 - line 41, abstract	1-4
A		5-17
	--	
A	US 4949395 A (NILS R C. RYDBECK), 14 August 1990 (14.08.90), column 1, line 50 - column 2, line 46	1-17
	--	
